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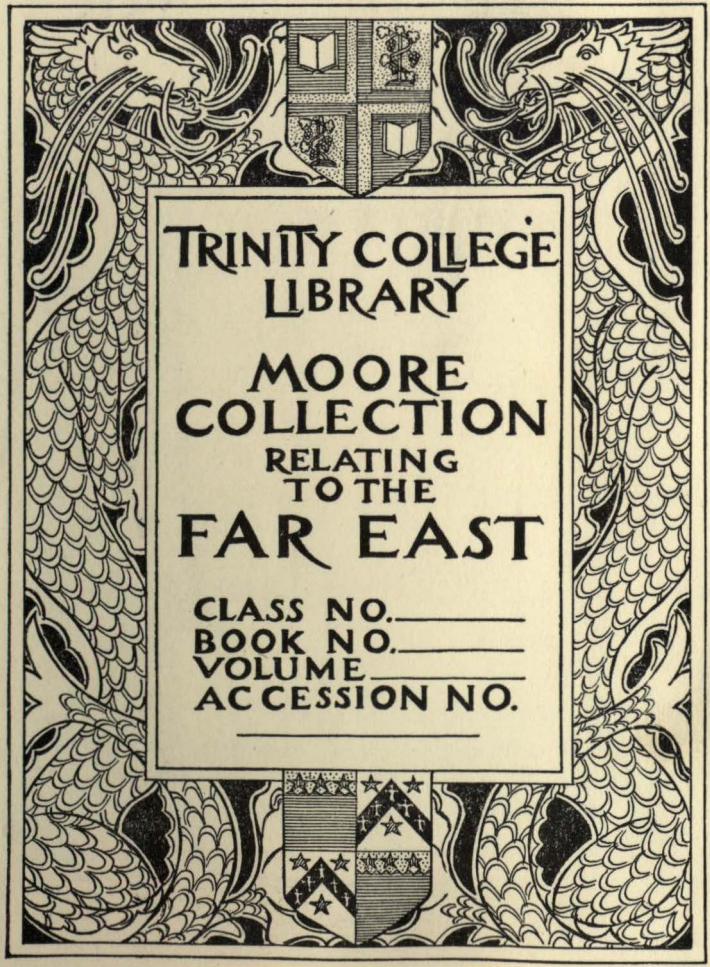
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Chapters on China and Forestry

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CHAPTERS ON CHINA AND FORESTRY

BY

Dau-yang Lin, M.F. (Yale)

Lecturer on Conservation of the Lecture Department of the National Committee Y.M.C.A.) and Special Lecturer to University of Nanking

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PREFACE

The two outstanding facts that impress themselves most forcibly on a stranger coming to China are, first, the multitudes of destitute poor, and, secondly, the immense tracts of unused lands, most of which is fit only for forestry. Are these facts related to each other as cause and effect? or are both effects of a deeper cause? Both these questions can be answered in the affirmative. Without a doubt the deforestation of China has come about through the neglect of officials and the lack of police protection. In encouraging farmers to allow the young oaks and other trees that spring out of the hillsides to grow to become trees fit for timber, I have often been met with the objection that if allowed to become valuable trees, some night there would be a raid and the whole best trees cut and carried off. However, as China is now firmly established as a Republic, and as wide-awake and public-spirited men are guiding the destinies of the nation, we look for better things.

The philanthropist no less than the statesman bemoans the lack of forests in China. When one

hears of bands of robbers keeping a whole district in terror, and preventing the development of the land in a district, something is wrong. After careful investigation one is forced to the conclusion that the reason for the opposition of these "robbers" is that the development of these lands has been attempted for the private gain of a few, while the multitudes are used as slaves to that end. Well is it for China that the spirit of liberty is so deeply rooted in her sons that rather than submit to slavery they turn around and despoil their oppressors. I know a district at Tai An Hsien that was pronounced impossible to develop because of the robbers of that district. Seventy-one families (379 men, women and children) have been located there, people who were destitute, and I may add desperate, and these families each owns its own land and not a cow or a chicken or a sheaf of wheat has been stolen since the beginning of the work. The robbers have become law-abiding citizens and the district is at peace.

Forestry, if considered from the side of trees only, needs no advocacy, except to those who shut their eyes. When the sleepers on a railroad cost one-third of the construction of a railroad line in China, because the timber for the cars must be purchased outside of China, one realizes the great

waste that is going on. The construction of the Railroad bed costs one-third, the rails cost a third, and the sleepers cost a third. This means that two-thirds of the money spent on the railroads are spent in foreign countries, and only the one-third that makes coolies out of the population is spent here. Coolie hire in China is cheaper than bringing in labor-saving machinery. That is, the life's blood of the nation is cheaper than labor-saving machinery. Let the men who dig and carry mud be put to planting trees and what will be the change? Let any one travel through any wooded mountains in China and look at the manly type of man that he meets, and the sturdy women and children, and compare them with the poor in these camps of coolie laborers. What a contrast! Independence versus slavery.

As China's mineral resources are as yet practically untouched and as she has barely begun to develop her manufactures, and as both these activities require a considerable amount of ready capital, she is compelled, in the immediate future, either to develop her lands which need little or no capital, or remain undeveloped. This means that the sixty per cent of the lands of China that are now lying idle must be put into use. These lands are fit only for Forestry. How can it be done?

Simply allow the poor of the land who are poor because of enforced idleness, and who heretofore have been driven off these unused lands if they attempted to use them, allow these people to break up the valleys and level spots in the mountains, and help them by something like the Rural Credits Banks that have been established in New South Wales, British Columbia, the United States, and other countries. If this is done and these colonists made the wardens of the forests that will spring up on the surrounding hills, China will have wood enough and to spare in a couple of decades, and she will have a crop of mountaineers that will be the terror to any oppressor or would-be oppressor of China.

Here is where China must begin if she is to be able to stand up and look any invader in the face. Only free men who love their institutions because they guarantee their freedom, will fight to the death for those institutions. You can not make heroes out of slaves or paupers or coolies. Let us begin at the right end in conservation, viz., the development of the Chinese people, and let Forestry and every other industry be used as a means to that end, and not *vice-versa*—the using of the people to develop forestry. The Forest Colony will work automatically and rapidly

and cheaply. People will naturally be interested in what benefits themselves.

This treatise of Forestry, showing as it does the many advantages to be derived from having the "big half" of China produce Forests instead of lying idle, ought to be read by every Foreigner in China who wishes China well, be he missionary, merchant, or statesman. Every English-speaking Chinese who does not read the book is neglecting a duty. I only wish that the writer, who is so well qualified to give us all information on Forestry and about whom his old teacher, Professor Fourney, Head of the Forestry School at Yale, told me so many good things when I saw him this spring, had written more fully. I hope he will "hustle" and bring out a bigger work in the near future. In the meantime, let us all master this volume.

JOSEPH BAILIE.

The University of Nanking,
5th October, 1916.

PREFACE

The information set forth in the following chapters is largely condensed and re-arranged from addresses made during lecture tours within the last ten months. Now prepared in English for the first time (Chinese version which gives a fuller account is already published) the chapters are offered primarily for the benefit of English speaking students and mission school teachers who wish to interest their students in the subject of forestry during Arbor Day celebrations, or in class rooms.

While traveling and lecturing in the different parts of China, the writer has time and again been asked questions like the following: "What is forestry?" "How important is forestry in a country?" "Can it be as important as agriculture?" "What are the economic effects of forests?" "How are forests related to streamflow, soil erosion, temperature, evaporation, floods, shifting sand, silting up of rivers, aesthetics, sanitation, etc.?" "What has forestry done in other countries?" "What have been the results of deforestation in China?" "What if China had taken up forestry?" "Under the present difficulties what practical suggestions

would you offer for China's immediate use?" Etc., etc.

The following discussion, therefore, is intended to answer the above questions, and inasmuch as it is going to serve as a sort of popular treatise, scientific details and lengthy discussions have not been elaborated upon and in many cases have been left out entirely. It is sincerely hoped that these few chapters may help in a way to hasten the awakening of our people as a whole to the importance of forests in the life and happiness of a nation.

The sources of this pamphlet lie in the forest literature in general. The writer, however, wishes to acknowledge his indebtedness to Drs. Schlich, Fernow and Schenck whose works he has freely consulted and quoted, and also to the Forest Service of the United States of America for much of the data upon which this pamphlet is based.

D. Y. Lin.

Shanghai, August, 1916.

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CHAPTERS ON CHINA AND FORESTRY

GENERAL CONSIDERATIONS

MEANING OF FORESTRY

"Forestry comprises the sum-total of all knowledge required for the best administration of the forests with due regard to the interests of the owners in particular, and to the interests of the commonweal in general."

It appears from this well-worded definition that forestry is understood to be a business of a somewhat socialistic tendency. Whilst all other business exists for the benefit of the owner, the business of forestry is expected to react beneficially on the welfare of the country.

It must be borne in mind, however, that the underlying idea of forestry is continuity of use. By that we mean proper use and not non-use. The best use consistent with maintaining the forest for future use should be the aim of all forestry practices.

There is in Switzerland a forest belonging to the city of Zurich that has been supplying wood in plenty for the use of the community for more than a thousand years, and is still a good forest

to-day. Such a forest will serve as a concrete example of what forestry is and what forestry ought to be.

FORESTRY AND AGRICULTURE

Forestry is "the twin sister of agriculture," both being concerned in producing continuously crops or equivalent money values from the use of the soil. Yet forestry is different from agriculture not only in the kind of crop produced, but also in the manner of producing the crop.

The element in production by which forest production differs from all other productive industries is the time element. Agricultural crops are usually ready for harvest the same year they are planted, or at least in a year or two. Orchard-crops require a few years to establish the basis for an annual or biennial return of crops. But a wood-crop is not ready for use until many years' growth has been accumulated. Now it is this long time element that makes forestry a business with many drawbacks. Benefits from it are not immediate, but distant. Consequently people who cannot wait for returns are averse to embarking on it.

In forestry no fertilizers are used except occasionally in nursery practice, while in agricul-

ture fertilizers are indispensable. This is because the annual fall of leaves and twigs in forests keeps forest soil fertile and constant; while annual removal of agricultural crops for market deprives the soil of its fertility, hence fertilizers are necessary.

Moreover trees take from the soil a smaller amount of mineral matter than do field crops. The following table will show the requirements of inorganic or mineral matter, per acre per year, in the farm and in the forest:

Substance:	K_2O	Ca_2O	MgO	P_2O_5	SO_2	SiO_2
Farm:	78	43	17	28	11	37
Forest:	4	9	2	1.4	0.4	1.6

It should not be assumed, however, that the trees are insensitive to the quality of the soil. On the other hand the contrary is the case. Recent experiments have demonstrated the influence upon the growth of trees, as exercised by a lack or an abundance of nitrates, phosphates, potash, and magnesia in the soil. The fact that trees grow faster on good soil than on poor soil is readily understood.

FOREST LABOR

On the whole, forestry requires only one-tenth of the labor required, acre for acre, for

farm lands. This has been proved in Germany where agriculture and forestry are most highly developed.

Forest labor is extensive while that on farm lands is intensive. The farmer is constantly busy during the progress of his annual crop, cultivating it to secure the best results. Ploughing and sowing are done annually, and if he apply himself to pasturing, his attendance upon the animal is incessant. On the other hand, the forester's crop grows mostly unattended. He can do but little to influence the progress of his crop, and must allow Nature and time to mature it. During harvest and seeding times, he may be busy, but they as a rule do not call for much effort.

Fortunately forest labor fits in well with agricultural work, being performed usually during winter time when agricultural labor is unemployed. This is important, especially where a dense poor population must find continuous employment throughout the year.

IMPORTANCE OF FORESTRY

It is a well known fact that trees can be grown on soil which is too poor for agriculture.

This is why so many of the so-called exhausted farms are redeemed almost invariably by the re-establishment of woods. Agriculture is remunerative only when it is practiced on agricultural rather than forest soil. Tree production should be on the poor soil rather than the rich, the rocky soil rather than the smooth, the steep slope rather than the gentle, the swampy land and the inundated district rather than the upland. It is on such lands that the business of forestry is most apt to be found remunerative.

"Every foot of soil in a country should be devoted uninterruptedly to that production under which it pays best." Inasmuch as agriculture cannot be practised on forest soil, and inasmuch as the lands of any country consist of both agricultural and forest soil, the place of forestry in a country becomes evident. No nation can ever hope to fully utilize her lands unless she gives due emphasis to both agriculture and forestry. To neglect forestry is to lay waste lands that are unfit for agriculture. The point raised ought to open our eyes, as Chinese citizens, to the existing conditions of our lands.

THE UTILITY OF FORESTS

The utility of the forest is two-fold:

First,—direct utility or utility to the owner. The owner here considers first the benefits which he personally derives from his forest. It is chiefly the produce that he is after.

Second,—indirect utility, or utility to the commonweal. The desire of the commonweal may be to conserve or obtain natural blessings (rainfall, health, etc.) derived, or supposed to be derived, from the forest, or to prevent losses or calamities (erosion, floods, etc.).

Often the private owner creates game preserves or parks. Game preserves are for sporting purposes while parks are created to enhance the beauty of the forests. It will be seen, however, that financial forestry, or forestry for yielding produce, always holds the leading position with the private owner. On the other hand, the State while concerned with direct effects of forests always appreciates the indirect effects, or the effects which forests have upon the country and the nation as a whole.

The following outline will give us a bird's-eye view of the utility of the forest, and we shall consider each of the subdivisions separately:

UTILITY OF FORESTS

Direct	Indirect
A. *Produce of Forests:*	A. They reduce the temperature of the air and soil to a moderate extent and render the climate more agreeable.
(a) Principal produce or wood.	
(b) Minor Forest produce: Tüng-yü, Turpentine, Rosin, Wood pulp for manufacture of paper, Tannin, Dye stuffs, Rubber, Lacquer, etc., etc.	B. They increase relative humidity of the air but check excessive evaporation.
B. *As objects of Industry:*	C. They tend to increase the precipitation of moisture.
(a) The capital of Forestry.	
(b) Labor required in Forestry.	D. They regulate the streamflow.
1. Administration.	E. They prevent soil erosion, shifting sand, avalanches and silting up of rivers.
2. Transport.	
3. Industries.	

F. They lessen the severity of floods.
G. They shelter cattle, game and useful birds.
H. They conserve water resources.
I. They improve the healthiness of a country.
J. They increase the beauty of a country.

PRINCIPAL PRODUCE OF WOOD

Wood is universally used. It is indispensable in human economy. It is said that a wood famine would be like a bread or rice famine. Such a statement is far from being exaggerated, for we need only to look around to find out for ourselves the extent to which wood is used. It surrounds us both as a convenience and as a necessity. Our houses, tables, chairs, bridges, pails, carts, spools, trains, boats, barrels, ties, farm implements, cradles, coffins, etc., etc., are all made either mainly or wholly of wood. There is hardly a tool which does not require wood for construction. It is stated that for every hundred tons of coal mined, two tons of mining timber are needed.

Every pound of iron, every ounce of gold requires wood in its mining, wood in its manufacture, and wood in its transportation. The same is true of all other industries. In 1909, timber, shingles, and lath worth G$724,705,000 were consumed in the United States (fuelwood not included).* Such an enormous sum should open our eyes to the importance of timber.

The consumption of timber and fuelwood per head of population in various countries is estimated to be as follows:

Great Britain.... 14 cu. ft. per head of population.
France..... 25 cu. ft. per head of population.
Germany..... 37 cu. ft. per head of population.
Canada.....200 cu. ft. per head of population.
United States...230 cu. ft. per head of population.

The consumption of fuel wood however decreases with countries that show a rapid increase industrially.

In the United States the annual lumber cut for 1913 was 38,000,000,000 board feet valued at one billion gold dollars. It was estimated that to turn out such an enormous amount of lumber as many as 24,000 mills were active and these represented an outlay of a billion dollars in capital.

*(New York Bulletin I, Page 16).

MINOR FOREST PRODUCE

Among the so called minor products of the forest we may mention turpentine, (wood-oil) Tung-yü, wax, lacquer, camphor, tar, tannin, rubber, pulp for paper making, dye stuffs, fruits, leaves, seeds, flowers, medicinal bark, resin, gutta-percha, fibres, bamboo, and many others. In western countries these minor products furnish raw materials for extensive industries. To illustrate this it may be mentioned that the United States in 1909 consumed more than G$34,000,000 worth of wood for the manufacture of wood pulp, and for tanning materials as much as 1,078,910 tons of bark, wood, etc., valued at G$22,000,000. According to a recent report the combined value of turpentine and rosin industries in 1910 was G$36,000,000. Such figures simply go to show the importance of the many minor products of the forest which furnish raw materials for extensive industries.

FORESTS AS OBJECTS OF INDUSTRY

Forests are important objects of industry because they represent a large amount of capital and they require labor in a great variety of ways.

The capital of forests consists not only of the soil and the growing stock of wood, but also of the industries that subsist wholly or mainly on wood. It is stated that in the United States the forest industries are second only to the agricultural interest, and they are far ahead of those of the earthly products, i.e., mines, quarries, etc. Twenty per cent of the capital of the United States, or G$2,250,000,000, is invested in wood industries. Seventeen per cent of all the manufactured products, having a value of G$3,000,000,000, comes from forest resources. (Cir. 171, U.S. Forest Service).

The National Forests of the United States have an area of 186,000,000 acres, and they contain approximately 600,000,000,000 bd. ft. of merchantable timber, worth at least G$900,000,000. The other resources are said to be worth probably $1,100,000,000 more, bringing the total value of the National Forests up to something like G$2,000,000,000.

These National Forests also contain 1,175 watersheds which supply cities and towns, 324 water-power plants, and 1,266 irrigation projects, developed or in the course of development.

Right here our attention might be called to the food fish which live in forest waters that furnish each year in the United States G$21,000,000 worth of food, and about half as much more is furnished by the game which could not exist without the forests.

When wood is put on the market in its final form, it is probably ten or fifteen times more valuable than it was as it stood as a tree in the forest, and no doubt practically all of this difference is due to the labor employed in working it up.

Forest labor consists of administration, tending, harvesting, and of the vast amount of work required to transport and to work up the raw material yielded by the forests. It has been calculated that in the forests of Germany about G $40,000,000 are paid annually for administration, preservation, road making, and harvesting, on which about 200,000 families, or 1 million people exist.

Wood is of a bulky nature: consequently a large amount of money has to be spent annually for its transport.

The quantity of labor required to work up the raw material yielded by forests is, however, much greater than that employed in managing the

forests and in transportation. There are workmen employed in saw mills, carpentry, paper pulp manufacture, matchmaking, carving, building, the manufacture of spools, pencils, coffins, telephone poles, railroad ties, wagons, steam and electric cars, turpentine, lacquer, rubber, Tungyü varnish, tannin, charcoal, excelsior, toys, toothpicks, and thousands of other industries. The wages earned in these industries amount in Germany to something like G$150,000,000 a year, which maintains about 3,000,000 people.

Germany is the most advanced nation in matters concerning forestry. It is estimated that about 12% of her population is employed in forest work and in forest industries. The importance of forestry from the standpoint of labor alone ought to open our eyes wider than ever before to the conditions existing in our own country, where we find thousands upon thousands of unemployed, many of whom become beggars or robbers.

The following statement is taken from a recent number of the "American Timberman" to show the importance of the lumber industries of the Northwest Pacific States (U.S.A.), as compared with all other industries:

centuries, allegedly through deforestation, in Mesopotamia, Palestine, Asia Minor, Egypt and Greece. These countries were once the leading countries of human civilization, but they have been long on the decline. People have asked time and again whether it can be true that destruction of forests has brought about national and economic decrepitude, and whether it can be true that the influence of forests on soil, climate, rivers and streams, health and economic conditions is so important as to make the conservation of forests a necessity in the life and prosperity of a nation. Evidently the answer to such questions must be a personal one. According to a famous German forester, however, the destruction of forests in any country is a sign rather than a cause of a country's decline.

We have seen something of the direct utility of forests, and what it means to the wealth of a country. Now if it were possible to compute in dollars and cents the indirect utility of forests, the value would surely far outweigh even that of agriculture.

We shall now discuss the subject of the indirect effects of forests under separate headings.

Forests and Temperature.

It has been found that forests lower the temperature of the air inside and above them and that the vertical influence of forests upon temperature extends in some cases to a height of 5,000 feet. The reason for the reduction of the temperature of the air is that forests exert a cooling effect and this cooling effect is due to evaporation among the leaves and to the fact that the heat of the sun is consumed in this evaporation.

It has been experimentally proven that for every pound of dry substance produced, corn evaporates 233 pounds of water and turnips 910 pounds. Now if ordinary crops can contribute to the moisture content of the air and the cooling which accompanies this evaporation, forests being the most highly developed form of vegetable life, should exert this influence in the greatest degree.

From a long series of observations continued for many years in France, Germany, Switzerland and the United States, it has been found that during the hottest days the air within forests is more than 5° F. cooler than that outside, while

for the coldest days of the year the difference is only 1.8° F. For Germany, according to the same authority, the summer extremes in forests are about 7° lower than those in fields, while the winter extremes are about 2° higher.

In tropical and subtropical regions, the influence of forests upon the temperature of the air is greatest. The remarkably moderate temperature of the Amazon Basin is attributed to the cooling effect of the enormous forest areas found there.

The influence of forests on the temperature of the soil is almost the same as that on the temperature of the air. The forest soil is warmer in winter by 1.8° F., and cooler in summer by from 5.4° to 9°F. than soil in the open, and this holds true to a depth of at least 4 feet.

Forests and Relative Humidity.

The relative humidity of the air is higher in forests than in the open. The difference is greatest during the summer months. According to Bavarian observations given in Schlich's Manual of Forestry we have the following tabulated results:

Season	Mean Rel. Humidity in % of Saturation		
	In open 5 ft. above ground	In forest 5 ft. above ground	Excess in forests
Spring	74.96	80.66	5.70
Summer	71.92	81.20	9.28
Autumn	82.72	87.94	5.22
Winter	84.19	89.43	5.24
Mean of year	78.45	84.84	6.36

The detailed figures show the excess of the moisture content of the air in forests over that in the open. Further investigations show that greater differences have been recorded according to tree species.

The reason for the higher relative humidity of the air in forests is that the temperature of forest air is lower and also because the leaves give out vapor (by process of transpiration) which thereby increases the moisture content of the air.

It is this higher relative humidity of air in forests that explains why air currents become relatively moist after passing through forests and why the formation of dew is greater in the vicinity of forests than on open ground away from woodlands.

Forests and Evaporation.

There is a great difference between the evaporation from soil in the open and in forest soil.

It has been found that when the leaf litter is left on the ground in forests the evaporation from forest soil is only about one fourth of the evaporation from field soil, but if the litter is removed, the proportion is about one half or less.

On the other hand it must be remembered that the evaporation from the crowns of the trees is enormous. This we have seen under relation of forests to temperature. In wooded regions the level of the ground water is lower than that in the unwooded regions. This is because forests give out vast amounts of moisture to the air (transpiration), and in so doing they draw and consume heavily the water that is stored up in the earth.

Forests and Precipitation.

Observations upon the relation of forests and precipitation began as early as the 60's, and it has been found that forests increase both the abundance and the frequency of local precipitation as compared with that of adjoining unforested areas, amounting in some cases to more than 25%.

The results of 30 odd years observations made at Nancy with 3 stations,—situated inside, on the edge of, and outside the forest—show a decided increase of rainfall in the forest. The increase in

the forest over that on the edge of forest is 7% and over that in the woodless country is 24%.

While it is true that precipitation increases with altitude and that mountains affect precipitation, it is also understood that wooded mountains affect it to a still greater degree. This effect is especially marked during the summer months.

The reason for the increased quantity of precipitation in wooded areas is because of "the tendency of moisture-bearing currents to precipitate their moisture more readily over or near the forests than over bare or cultivated fields at the same elevation, due to the dampening and chilling effect of the forest upon the atmosphere which induces a greater condensation of water vapor."

Another reason that is often given for greater precipitation over the forest is the mechanical action of the trees themselves. When a cloud in the mountain passes through a forest, the leaves and the branches of the trees retard its movement, causing the moisture in suspension to precipitate.

It has also been found that large areas of forests will greatly enrich with moisture the air currents that pass over them and that these moisture-laden air currents or winds will benefit the regions into which the currents flow. It is

on account of this that some American scientists have been led to believe that if all or part of the forest in the Atlantic plains or in the Southern Appalachians, in the United States, was destroyed, it would mean that there would be less precipitation in the Central States and the Prairie region.

Forests and Streamflow.

The effect of forests upon streams in level countries is unimportant but in hilly and mountainous countries they are conservers of water and tend to maintain a steady flow of water in the streams.

In the mountains the greatest loss of rain water is through surface run-off (water that washes off the surface of the ground) and the most important influence of a forest cover is in reducing this. It is stated that the amount of water saved in this way by the forest is 20% to 35% and often more with higher altitudes.

The reason why the forest is able to check surface runoff and save portions of it to the soil are: first, because the trunks and the underbrush in the forest offer mechanical obstruction; second, the litter of the forest floor checks rapid surface drainage of the water and also acts as a sponge; and, third, the network of deeply penetrated

roots, living and decayed, make the forest soil more porous and permeable:—hence the water sinks into it more readily.

It is evident that the ability of the forest to check surface run-off is greatest when the forest is dense and when the ground beneath it is covered with an unbroken leaf litter.

It must be borne in mind, however, that when water is precipitated from the clouds, portions of it are prevented from reaching the ground through interception by the leaves, branches, and trunks of the trees. This intercepted portion varies according to the tree species and the density of the woods. According to Bavarian investigations, it averages 23% of the total rainfall. So after a rain, we often find that water continues to drip from the leaves and twigs for hours.

Having gone over the different factors which tend to influence the amount and the rapidity of running water in forest clad watersheds, we are in a position to understand the relation of forests to streamflow.

In forested regions, rain water is conserved in such a way that it is allowed to drip slowly down, so to speak. So we find that in such regions

streams do not rise high immediately after rains and do not dry up when there is no rain, and there is always a great abundance of springs which go to feed such streams. Forests and forest soil are like large reservoirs for the conservation of rain water for streamflow.

Forests regulate streamflow by conserving not only water but also, in colder climates, snow. That forests retard the melting of snow has been demonstrated in a series of observations carried on at Moscow. Results show that the period of snow melting within forests is from 26 to 57 days, while snow in the open disappears within 6 or 7 days. The ability of the forest to retard the melting of snow is due chiefly to the shade and protection given by the trees and the underbrush, and such gradual thawing will render it possible for streams to be slowly fed—hence a more even streamflow.

Forests and Erosion.

When water rushes down a bare slope, it possesses great mechanical power. It loosens the soil and carries it down hill. It makes gullies and causes landslips and ravines to form. The soil brought down not only renders the fertile land

below valueless, but also goes to the silting up of otherwise navigable streams.

It is generally understood, however, that of all the vegetable covers forests are most efficient in protecting slopes from the erosive action of water. This is because, first, the roots of the trees and the layers of humus hold the soil firmly in place and so increase its resistance to erosive action; second, the crowns of the trees protect the earth from the violence of beating rain and intercept a considerable portion of it; third, the velocity of the moving water is checked, because of the reduced amount of the run-off, hence the erosive force of the run-off itself is minimized. On the whole we may say that on a forested slope a series of obstacles is always present to oppose the movement of the water and reduce its velocity and force, and consequently its erosive action.

The importance of a forest as an effective agency for protecting the soil from erosion has been recognized for centuries in Europe. The so-called "Protection Forests" in France, Switzerland and Austria were created with the express purpose of protecting mountains and hills and of preventing communities from being impoverished by floods and torrents which destroy and silt over

fertile lands at the foot of the mountains. Wherever extensive deforestation has taken place in a country, the consequence has been the gradual formation of a series of torrents, the abandonment of farms, the rapid silting up of river channels, and frequent visitations by floods. To remedy these evils great efforts have to be made to reafforest the denuded areas. France has experienced this and millions of dollars have been spent in the work of reforestation.

Forests and Shifting Sand and Avalanches.

Forests protect the soil not only in the hills but also in low lands wherever it consists of so-called moving or shifting sand. The action in this case is due to their moderating the force of the winds and to the action of the roots of the trees in keeping the soil together. France furnishes perhaps the most striking and most extensive example of how such shifting sand, the dunes and sand hills in the plain, may be changed by a forest cover from a useless and dangerous condition into one of profitable occupation.

Forests have also been recommended as remedies for avalanches. Although most avalanches originate above the timber line, or the upper limit of tree growth, there are, however, many cases

where the presence of a well-preserved forest will prevent the formation of avalanches or stop their forward movement, and hence protect the towns and villages below. Many forests in the Alps are maintained in this way as a protection against avalanches.

In European Russia a law was passed for the creation of "preserved forests." It should be of interest to know the conditions under which woodlands may be declared "preserved forest." The conditions are:

(1) When they serve as preventives against the formation of barrens, shifting sand, and the encroachment of dunes along sea shores or the banks of navigable rivers, canals, and artificial reservoirs.

(2) When they protect from sand drifts towns, villages, cultivated land, roads, etc.

(3) When they protect the banks of navigable rivers and canals from landslips, overflows, or injury by the breaking up or passing of ice.

(4) When they serve to check land or rock slides, avalanches, and sudden freshets, when growing on hills, steep places, or declines.

(5) When they protect the springs and sources of rivers and their tributaries.

It is said that in these "preserved forests" working plans are made at the expense of the government and that one hundred million acres of private forest land have thus come under government supervision.

Forests and Floods.

From the relation of forests to streamflow we can readily see the relation of forests to floods. It is evident that deforestation will always influence small rivers and streams and cause floods that are local in extent.

The following flood and low water records for 6 important rivers in America, taken from Circular 176 of the Forest Service of the United States, should be of interest:

I.

FLOODS INCREASED (On account of deforestation)

Name of River	Point of measurement	High-water stages taken in this table	Low-water stages taken in this table	Years	Number of Floods	Days of Floods.	Low-water Data	
							Number of Low stages	Days of Low stages
		Ft.	Ft.					
Potomac	Harpers Ferry, Va.	12	3	1890-1898	19	33	54	1 351
				1899-1907	26	57	76	1,693
Monon-gahela	Lock 4, Penn.....	20	7	1886-1896	30	55	66	912
				1897-1907	53	100	90	979
Ohio	Wheeling W. Va.....	22	5	1882-1894	46	143	79	1.333
				1895-1907	59	188	110	1,609
Cumber-land	Burnside, Ky.....	25	3	1890-1898	32	89	61	1.261
				1899-1907	43	102	65	1,576

II.

FLOODS DECREASED (On account of cultivation & plantings)

Wabash	Mt. Carmel Ill.....	15	3	1890-1898	21	351	38	1,365
				1899-1907	19	279	44	1,160
Red	Arthur City, Tex...	20	4	1892-1899	19	87	49	826
				1900-1907	16	60	8	208

The rivers that show increased floods are the Potomac, the Monongahela, the Ohio, and the Cumberland. The authors of the circular claim that the increased floods have been caused not by the soil or by topographic or climatic conditions of the various regions but chiefly by the removal of forests on the watersheds where these rivers rise. In the case of the Wabash and the Red Rivers, they ascribed the decreased flood conditions to the fact that "their watersheds of prairie soil, compacted for ages by the trampling of buffalo and more recently of cattle, of the great ranches of the West, have been to a large extent brought under cultivation and planting."

The results of such extended investigations are significant. Although they may be restricted and local in character, yet they show that the relation of forests to floods, or rather to the frequency and duration of floods, in many rivers is not unfounded.

It is often said, however, that floods are produced by exceptional meteorological conditions which are uncontrollable and that the fluctuation in the total amount of water carried by rivers during a long period of years depends upon climatic cycles of wet and dry years. While

this is absolutely true, we must also admit that forests are a great help in controlling destructive waters, hence in lessening the severity of floods.

Forests and Air Currents.

The windbreak effect of forests is very important especially in regions where there are frequent cold or dry winds. By breaking the velocity of dry winds, and possibly enriching them with moisture, the rate of evaporation over a neighboring field is considerably reduced and it has been found that in regions where such winds are common, the protection shows itself in increased crops on protected fields.

That protection against cold winds in wooded regions has resulted in making life and work more enjoyable is a recognized fact. The same protection has facilitated the wintering of cattle, sheep and hogs in some regions. Protection of wild life has been emphasized and this can not be permanently effected unless woodlands are present.

Forests and Water Resources.

One of the principal purposes which underlies the establishment and maintenance of forests is the protection of the source of water supply. This is well brought out by Henry S. Graves,

Chief Forester of the United States, writing on the relation of the National Forests to the American farmer. He says: "The protective influence of the forest-cover on the sources of water supply is of importance to all industries using water from streams rising in the National Forests. It is of special importance to the agricultural interests. In many parts of the West (meaning the Western States of the United States) the water used in irrigation is derived almost entirely from streams which have their source in the National Forests. This is true of the majority of the great reclamation projects of the government which furnish water for many hundreds of thousands of acres of land. Every farmer who uses water is, in a measure, directly dependent in the long run on the proper handling of these National Forests. In several instances National Forests are maintained primarily for the purpose of watershed protection. . . . In the steep mountain ranges of southern California the use of pine forests high up on the watersheds is absolutely necessary for conserving the water needed to irrigate the citrus-fruit farms in the valleys below. . . . Not only do individual farmers get the water used in their homes and for their stock from streams rising in the forests, but many small towns and

communities are thus supplied. Altogether about 1,200 towns and cities depend on National Forest Water."

Such significant words by an American authority should call our attention to the present conditions here in China where the water supply for irrigation is a question of life and death with our millions of farmers. Surely it is no exaggeration to say offhand that the value of many of our farms would be greatly increased by proper conservation of the water supply for irrigation and other farming purposes.

Forests and Health.

That forest air is more healthful than the air over fields is a recognized fact. This is explained by the presence of ozone and the absence of bacteria and dust in the forest air.

Direct observations by Professor Ebermayer show that the amount of ozone in the air is greater in forests than over fields and exceeds by far the amount of ozone in city air. This is on account of the abundant production of oxygen obtained by the decomposition of carbon dioxide in the air (photosynthesis). It is said that ten acres of forest exhale in the course of a day as much oxygen as is needed for the life of sixteen men.

in China have become unattractive and often ruined on account of the forest depletion which has taken place. It seems that the preservation of these places must go hand in hand with the conservation of forests.

Right here our attention should be called to the extreme lack of pleasure resorts and playgrounds in the life of our nation. No doubt it is this lack which has been responsible for the prevalence of the so-called sparrow and tien-kyu playing, fantan, and other forms of gambling among our people. The point may be well taken up from the standpoint of park or æsthetic forestry.

WHAT FORESTRY HAS DONE

To appreciate better where our country stands in matters concerning forestry, let us now examine what forestry has done and what forestry can do in other countries.

It is a well-know historical fact that progress in forestry the world over has been made at the sharp spur of want, suffering, or loss. Forestry work is a work undertaken as a measure of relief and continued as a safeguard against repetition of this want, suffering or loss experienced.

As a rule the countries which have gone farthest in forestry matters are those that have the least proportion of waste land, and which have the most promising futures.

We will now consider the forestry conditions of a few countries. The review may be incomplete, but it will show what forestry has done in these countries.

Germany is the most developed country on earth, and so her forestry is the most advanced. One hundred and fifty years ago Germany felt the pinch of wood shortage, and so she began to take up forestry. To-day not only all her government forests have become well managed, but also all the private forests. Forestry work has been made everybody's business, and the people as a whole have cultivated the habit of planting immediately after cutting.

In addition to the question of wood shortage, Germany like other advanced countries was forced to undertake forestry by the need of protecting agriculture and streamflow. The troubles which France was having with her mountain torrents opened the eyes of the Germans to the dangers from floods in their own land. As a result, the maintenance of protective forests was provided for

by Bavaria in 1852, by Prussia in 1875 and Württemberg in 1879.

Germany now has 35,000,000 acres of forests. Of this vast area, 46% belongs to private individuals, 32% to the state, 16% to communities, and one-half of the remainder to the crown and the rest to corporati ns. This gives three-fifths of an acre to each citizen.

Each state in the German federation manages its own forests. All of the states practice forestry with success. The method of management adopted called for a sustained yield—that is, no more wood is cut than the forest produces. Under this management the growth of the forest, and consequently the amount cut, has risen rapidly. The following data taken from Prussian forests will show this:

In 1830, 20 cubic ft. per acre were produced.
In 1865, 24 cubic ft. per acre were produced.
In 1890, 52 cubic ft. per acre were produced.
In 1904, 65 cubic ft. per acre were produced.

Again, in the financial result, the following data taken in Prussia shows that returns increase as forest management becomes more intensive:

In 1850, G$0.28 was the net annual per acre.
In 1865, G$0.72 was the net annual per acre.

In 1900, G$1.58 was the net annual per acre.

In 1904, G$2.50 was the net annual per acre.

What, then, has forestry done in Germany? Starting with forests that were in bad shape, producing in 1830 only 20 cubic feet per acre, she had in 1904 forests that produced almost three times that amount of wood per acre. Again in 54 years the net financial return per acre increased almost nine times. (For total net revenue from Germany's Government forests, see Page 74)

In Germany there are many states, but the state that manages its forests best is Württemburg. It is estimated that this state has an annual net income of G$6.00 per acre.

To show the importance of forestry as a state activity in the German federation, it might be mentioned that the value of the Bavarian state forests is estimated to be as follows:

Timber	G$400,000,000
Soil	75,000,000
Total	G$475,000,000

The gross receipts for the several recent years from these forests are:

1890	G$ 7,000,000
1900	9,000,000

1908.....G$10,000,000
1910.....14,000,000
1914.....16,000,000

It is said that the state legislature (Bavarian) had the forest budget for 1915 under consideration for seven days during May last year. The expenses are now 49% of the gross income.

Japan. The administration of forest lands which cover 59% of the area of Japan is of great importance and should be of special interest to us Chinese. The forests are divided into five classes:

1. State Forests, owned by the Central Government and under the control of the Department of Agriculture and Commerce. Of these there are 33,000,000 acres.

2. Crown Forests, owned by the Imperial Family and under the control of the Household Department. There are 5,500,000 acres of these.

3. Public Forests, belonging to the prefectural governments, towns, and villages, and under their control, 8,300,000 acres.

4. Temple and Shrine Forests, self-governed, and amounting to 500,000 acres.

5. Private Forests, owned by individuals. Of these there are 16,000,000 acres.

The net revenue from state forests has risen 16%, and is estimated to be G$8,000,000 a year.

The Forestry Bureau controls the entire state forests, which are administered in a very effective way.

The Bureau is composed of 20 secretaries, 23 assistant secretaries, 82 higher experts, 1,426 clerks and assistant experts and 1,321 forest inspectors and rangers, some 2,872 altogether.

The whole personnel is made up of men trained in Forest and Ranger Schools.

The national state lands are well managed and even the private forests are under government supervision. Where private forests protect slopes, they cannot be cleared without permission, but must be handled so as to keep the forest cover intact.

Reforestation is carried out to a considerable extent both by the State foresters and by encouragement of private planting. An interesting feature in connection with planting is what is known as the "sharing forests" which are planted by private individuals on lands owned by the State and the income from such forests is shared between the state and the planter.

To encourage private planting, especially of useful timber trees, subsidies are often granted, and forest seeds and seedlings raised at government nurseries are distributed either free of charge or at a low price. It is estimated that not less than one million acres of communal property has been set out with trees and about half a million acres of vacant land in state forests has been planted. Planting is done not only on cut-over lands, but also on sand dunes, along coasts where fisheries are important, and near mining districts where forests are needed for the supply of timber for mining purposes. In Formosa special attention is paid to encouraging the development of the camphor industry by distributing seedlings, by granting free leases of land for plantations, etc., and this is why the greater part of the world's supply of camphor comes from Formosa.

India. Since British conquest, forestry has made rapid progress, chiefly due to the work of Dr. Brandis. When forest laws were first enforced, timber merchants, especially dealers in teak, protested because they did not want any check to their ruthless cutting. But they soon saw the importance of these forest laws.

The laws passed in 1878 provide:

1. Power to declare government lands to be reserved state forests.

2. Power to demarcate and to settle rights to them, and to withdraw such rights whenever they prevent conservation.

3. Power to provide protection and management.

4. Power to protect forest produce in transit.

5. Power to punish for offence.

To-day India has a very efficient forest administration. The Forestry Department has a large and efficient force of more than 11,000 men who have charge of about 149,000,000 acres, one-fourth of the total area of India under British rule. 3,000,000 acres are managed under working plans, and more than this are protected from fire. Reforestation has been carried on and thousands of acres have been planted, and these, consisting of teak mostly, will materially increase the output of teak hereafter.

The annual net revenue from state forests has risen in 40 years from G$240,000 to $3,300,000 gold. It is estimated that the value of forest produce exported annually is $144,000,000 gold.

Switzerland. In Switzerland foresty received attention from very early times. Many hundred years ago, the city of Zurich began to make rules for the management and protection of Sihlwald, a forest which she still owns and which now yields an annual net return of about G$12 per acre. The first general forest law was passed as early as 1725. It embodies all the important principles of wise legislation as we know it to-day. Since passing the law, the Swiss people have grown more willing to place restrictions on themselves for the good of the whole nation.

There were great floods in 1834 and at that time they hastened the enforcement of forestry laws. To-day all the forests on the higher lands have been made protection forests, to protect the lands below against floods, avalanches, etc. It is estimated that since 1872 G$2,400,000 has been spent on reforesting and G$50,000,000 on stream control.

Switzerland has 21%, or 2,000,000 acres of her land under forest. Of this 67% is communal, while the rest is private. Private forests are managed like the national forests. They can be cut only with the consent of the government and must be reforested within three years. Switzerland has many nurseries, these occupying 781 acres.

France. The French forests are also well managed. They cover about 18% of the country and yield about 40 cubic feet per acre per year. The working force numbers about 4,400 trained men. The cost of management of these forests is G95 cents per acre, or about G$3,000,000, and the government gets some $2.00 per acre net profit, or $4,737,000 a year. Both public and private forests are under government supervision.

The most noted work of the forest administration in France, and for which it deserves high credit, is that of the reclamation of waste lands. In 1879 it was estimated that there were still 20,000,000 acres of this waste land.

The movement for the recovery of the waste lands dates from the beginning of the 19th century. Not only is the government doing the work, but also private owners, encouraged by legislative acts. Within the last 60 years about 3,000,000 acres once lost to forest production have been restored.

There are five definite regions of large extent in which systematic effort at reforestation has been made: (1) Gascony Sanddunes; (2) Landes, in southwest France; (3) the sandy plains of La Sologne; (4) Limestone wastes of Champagne; (5) Mountain slopes in Vosges and the Jura Alps.

The following description of the work in the five regions is taken in part from Fernow's "History of Forestry," and it ought to be of special interest to us:

1. Sanddunes on the coast of France comprise 350,000 acres, those on the coast of Glascony in southwest France alone having 250,000 acres. These dunes were endangering the adjoining pastures and fields and often overwhelming towns and villages. The lands occupied by these dunes were originally forested and the dunes were caused by deforestation. As early as 1717 beginnings at reforestation were made, but no systematic effort was made until 1800 when Bremontier submitted a detailed report of the place. These dunes used to be useless and a danger to society. But to-day, after spending several million dollars on them, they have been reforested and changed into productive lands.

2. In Landes there were 2,000,000 acres of shifting sands and marshes, on which a poor population of shepherds (on stilts) used to eke out a living. In 1873, Chambrelent, an engineer, conceived the idea of improving the region by reforestation. He went ahead and worked, and as a result 1,200 acres of the worst marsh was recovered by ditching and planting. The success of his

work induced imitators, and later on the government co-operated. Now the whole section is covered with pine forest, and it is estimated that they have spent more than G$10,000,000 in the work. They are not throwing their money away: they are investing it. The 2,000,000 acres have been changed into productive lands. An estimate of recent date places the value of the recovered area at G $100,000,000!

3. In La Sologne there were 1,250,000 acres that had been abandoned because stagnant water, resulting from poor drainage, had made the place unhealthful. This land was once described as a paradise, but during the eighteenth century it was deforested, making it worthless. About 1850 a number of influential citizens constituted themselves a committee to begin the work of recovering this land. The Director General of Forests was made the chief of the committee. Canals were dug and roads made. Planting immediately began. To-day the whole territory has been recovered. These pine trees have grown and their value is estimated at G$18,000,000.

4. In the Province of Champagne, south of Rheims, a plain of arid limestone wastes of an area which in the 18th century had reached 1,750,000 acres, is to be found. The movement

for the recovery of these wastes began in 1807, first in a small way, gradually gaining strength, and to-day over 200,000 acres have been planted and reclaimed. These lands were sold without measurement, because they were worthless, but to-day reforestation has made them worth $40 or more an acre. And the work is still going on.

5. France is unfortunate in having within her territory about two-thirds of the torrents of Europe. Before the Revolution the mountains were protected and no clearing was allowed. During the Revolution restriction vanished. Ruthless cutting began. Cutting, fire, etc., went on until 8,000,000 acres of land were rendered useless and the people living in the region had to leave. Torrents were doing great damage, inundating plains, tearing away fertile land and silting up rivers. This went on until Surell in 1841 made a special study of the region and in his "Etude sur les Torrents" he called the attention of the people to the relation of forests to torrents, and emphasized the need of tackling the problem at the sources. Work was then started, but it was not until 1882 when the Reboisement Law was passed that systematic work was taken up. The government began whenever necessary to buy lands

and plant them for protective purposes. The work is still going on to the satisfaction of both the people and the state. About G$15,000,000 have been spent already, and it is estimated that G$25,000,000 to $30,000,000 more will have to be spent to complete the work. Of the 1,462 torrents, 163 are entirely controlled and about 650 have begun to be "cured." It is said that among the 163 that are controlled, are 31 which fifty years ago were considered by engineers as incurable.

Such has been the work of the French government in reforestation. They certainly deserve admiration. We have considered here at some length their work, because we know that China will have to undertake the same kind of work in the near future. The enormous sum that the French government has spent on reforestation ought to give us some idea regarding our problem. China is twenty-one times larger in area than France. How much more shall we have to spend? The number of torrential streams in China is terrific, and the amount of waste land is appalling.

Perhaps at this point our attention might be called to what has already been done for us within our own borders. In Tsingtao we see wonderful plantations of pine and other trees set out by the

Germans in their efforts to reclaim waste lands in and around Tsingtao. In Hongkong the British Government has started a scheme of issuing forestry licenses for the protection of young pine plantations and for inducing the natives to reforest bare lands. "This scheme," says Mr. N. Shaw, "seems to have suited the Chinese, as there were only a few breaches of the rule."

FORESTRY CONDITIONS IN CHINA

China has always been held up before all civilized nations as a horrible example of forest neglect. What forestry has done in other countries stands in bold relief against the background of deforested China. Deforestation has been allowed to go on for centuries and perhaps it will continue for many years to come.

One of the forlorn results of forest devastation in China is the scarcity of wood. This is being acutely felt and will be more so as time goes on. The new development in railroad, mines, and modern industrial establishments, and the change from the old type one-story building to the building of modern three-story, or higher, buildings is daily increasing the demand for wood in China. It is estimated that the greater portion

of the present consumption is still from home supply, but this source of supply is becoming more and more limited and difficult to secure. This is accounted for by the gradual receding of forests to inaccessible places, and to get timber out of such places is very difficult and consumes lots of time, especially when the transportation problem in China is such a difficult one. It is said that from the forests in Southern Hunan Province it takes from one to three years to float down the rafts of logs to the markets on the Yangtse River, and that it takes even more time from the forests in the more distant provinces to the main markets on the Yangtse. If this is true, we can see why there is such a large importation of foreign woods every year into China, and why "it does seem absurd that China should have to import lumber from Sweden."

Our largest sources of foreign supply to-day are Japan, United States, Russia, Siberia, Korea, Philippine Islands, Canada and the Indo-Malayan district. The so-called "Oregon pine" which is being shipped to China in such large quantities is called "China quality," and includes much that is not marketable in the United States and which the Pacific Coast American lumbermen are more than glad to dispose of. But, as is to be expected, even such quality commands a good price in

China. Our railroad ties, timber for ship building, mining, and the construction of wharves and modern houses, etc., are all imported from foreign countries, chiefly from Japan, Australia and America.

In the March issue, 1916, of the "Far Eastern Review," we find the following statement regarding the lumber industry in Hokkaido, (which contains 25% of the vast forested area of Japan):

"In 1914, the last year for which statistics are available, Hokkaido exported pine and oak and a small amount of other Japanese wood to the value of Y6,519,222. Practically all of the export material was for furniture-making and for railway sleepers. Of the entire amount, China and Manchuria took approximately one third."

Looking over the lumber trade conditions of China for the years 1912, 1913, 1914, we note the lumber import for 1914 was more than double that for 1912. It is but natural for us to expect a still greater increase with the industrial and social changes that are going on so rapidly in China.

It is estimated, we are to-day consuming about 2,400,000,000 board feet of lumber (mostly home supply) per year, worth M$64,000,000. For a

population of 400,000,000 based on the industrial organization of such an economical wood using country as Germany, there would be needed, according to an American forester, at least 30,000,000,000 bd. ft. of lumber a year. Assuming that by extra economies and a development of substitutes, China, after developing along modern industrial lines, could get along with one half that amount, or 15,000,000,000 bd. ft., even this at an average value of $35 per 1,000 bd. ft. would amount to $525,000,000. Where are we going to get this amount? The home supply is decreasing yearly.

We have about 6,000 miles of railroads and doubtless many more thousands of miles will be added within the next decade. These 6,000 miles of railroads lie on not less than 12,360,000 wooden ties and require 2,470,000 ties annually for renewals. Where have we been getting our ties? In North China, we use Japanese ties. In Central and South China, Australian ties are used. We cannot very well build a railroad line without paying large sums for imported ties.

Deforestation and the results thereof are familiar to all. Travelers have always called attention to it. Many naturalists have expressed thanks to monks and to the useful idea of

Fungshui, for they have preserved many forests and trees that would have become extinct.

In the interior we often see that because of the scarcity of fuel farmers have to go miles to cut grass and dig roots for fuel.

I have a piece of wood sent to me from Szechuen. This kind of wood used to be very abundant, and the price of it low, but to-day through ruthless cutting it has become so scarce that it is said coffins made out of it will cost from $2,000 a piece, showing that on account of the scarcity of timber we are having a high cost of dying!

The physical effects from deforestation are equally bad. A host of foreign observers, missionaries and officials, have for many years borne witness to this fact and deplored the consequences which have brought disaster time and again. We have thousands of bare and denuded hills and mountains that have become a constant danger to society. We frequently hear about land-slides, the wrecking of boats, torrential streams, abandonment of farms, the dredging of rivers, floods, famines, etc., etc. These are not unexpected calamities; they are but natural results of the wanton use of our water and forest resources.

One can not appreciate the effects of deforestation, unless he has been into the interior of

China. The vast tracts of land in Kwangtung, Shansi, Shantung, and the Yangtse plains have been rendered waste,—not because the mountains and hills have ceased to produce wood, but because the valleys and slopes, left unprotected, have become unfit for agriculture. We have seen how destructive it would be for unrestrained water to rush down the slopes, making gullies, washing and flooding the fields below. The writer still remembers most vividly the time in Pukak (a village in Kwangtung) when after a rain of fair size he had to walk through the flooded rice fields located at the foot of some denuded hills. Even the elevated paths between these fields were absolutely covered with flood water and it was a sight to be remembered.

Traveling in the northern interior of Fukien we see many tea farms. Some of these farms have been abandoned. Why abandoned? Because they have become so eroded and the soil has been so robbed of fertility, that these tea bushes simply do not grow, or do not produce sufficiently to warrant the continuance of their cultivation.

Forests regulate the flow of streams. Even stream flow is important for navigation. The

rapid rise and fall of the flow of some of our streams has been a great hindrance to navigation and hence to the development of our internal commerce. The people of Yenping, Kienyang, and Shaowu, in Fukien, tell us that in rainy days the Min River will rise to 30 or more feet high, often to the level of their busy streets, and that when there is a deficiency of precipitation it becomes rockstrewn and exceedingly dangerous to navigation. The mountains and hills along the Min are well wooded up to Yenping, but after passing Yenping the river goes into a territory which is treeless and often bare, and this accounts for the great difference between high and low water.

Again, in Chekiang, why is it that on rainy days the Chientang rises abnormally to 10 or 15 feet and not infrequently floods the fields on both sides? Why, when it is not raining, does the river become almost unnavigable for small flat-bottom boats? The mountains along the Chientang are almost treeless; in many places they are bare of vegetation of any kind. Forest fires are seen everywhere. Occasionally a few clumps of pines may be discerned, but as one Civil Governor has described them, they are for the

benefit of the dead whose habitation seems to need protection more than that of the living.

One botanist has said, after pointing out the serious effect of the loss of forests on the climatic conditions of China: "The effect on the general contour of the land from erosion, the depredations made by extension of river-beds, from silting and the exposure of crops to full climatic conditions, should engage the serious attention of those interested in the welfare of the agricultural population." The words of such a far-seeing foreign observer should be taken as a warning.

It is estimated that the Mississippi River carries to the sea every year enough finely divided silt—the choicest alluvium and the most fertile part of America,—to spread one foot thick over 350 square miles of land. If this is a fair estimate, we have some idea regarding what our three great rivers,— the Yellow, Yangtse, and Pearl,—are doing every year, when we come to think that watersheds for our three rivers are much less wooded than those for the Mississippi. The enormous loss of fertile soil has resulted not only in the abandonment of our farms, but also in the filling up of many otherwise navigable streams. Reforestation is no doubt one of the best and most permanent means of checking this loss.

We have many floods every year, and the number is increasing yearly. It is needless to enumerate the floods we have had or to mention the misery and loss they have caused. We have had floods this year, we are going to have them next year, and will continue to have them for years to come. Now floods are most destructive. A flood in the Seine, in France, in 1910, is said to have cost that nation $400,000,000 Mexican. How many billions of dollars have we already lost from our different floods? Can they be prevented? Yes, but only at great expense. Forests alone will not prevent them. We must all admit, however, that forests do lessen their severity and will stop some of them that are local in extent.

Ordinarily countries with a forest area of 20% or less show bad climatic conditions, with prolonged droughts, frosts, and alternating floods and low water. Portugal, with a forest area of only 5% of the total land area, Spain with 13%, Italy with 14%, are good examples of this. Just how much forest area China has nobody knows, but from what has been written about it and through correspondence and interviews, the writer is inclined to think that the per cent of area forested in China is fearfully small, perhaps too small to be considered. If the forest area were so

insignificant, it is no wonder China has been suffering from bad climatic conditions within her bounds.

TESTIMONY OF SOME FOREIGN OBSERVERS REGARDING CHINA'S DEFORESTATION.

For upwards of a century foreign observers—travelers, missionaries and scientists—have borne witness to and deplored the appalling consequence of deforestation in China and their testimonies ought to be a warning to us.

A German forester commenting on the forestry conditions in China said: "At the present the destruction of forests is for the most part completed and the effects have been most disastrous. There is no other country which teaches so thoroughly the lesson of the influence of forest soil and waterflow; for here for thousands of years the many extensive mountain ranges in the south, and the plains and mountains in the north, have been deforested; desert conditions and appalling floods in the rivers are the results."

The journal "Notes and Queries," according to Mr. Norman Shaw, author of "Chinese Timber Trees and Timber Supply," contains in a number

published in 1869 the following interesting account of the condition of affairs at that time: "In a thickly populated and highly cultivated country like China but few remnants are found of the original forests, and these few owe their preservation to the vicinity of the monasteries, the sacred character of the localities, and the, in this case, very useful ideas of fungshui; but the sentimental appeals of the priests and poetical associations of places and scenery, and even the powerful considerations of fungshui, appear to be on the wane and to be giving place to more utilitarian views; for in many spots where monastic influence has for centuries preserved larger or smaller tracts of forest land from denudation of their trees, ruinous temples stand with but a few isolated trees near, sparse mementos of the luxuriant groves in which the buildings originally reposed in the depths of magnificent forests."

Mr. N. Shaw writes: "In the densely populated regions of the Great Plain this destruction of forests bears fruit in the train of calamities due to flood or drought, consequent on the removal of Nature's covering of the earth; and in the loess provinces of the north a progressive desiccation and the encroaching of the sands from the desert are discernible."

Mr. W. F. Sherfesee, co-Director and Adviser of the recently organized Forest Service of China, wrote of his recent trip into the interior of Anhwei as follows: "To me, at least, the most astonishing fact revealed by these investigations is the great extent of excellent land lying waste on hill and mountain. In many places the population is overcrowded and desperately poor, yet in the very vicinity, rising perhaps from the out-skirts of the over-populated towns and villages, rise fertile but unused hills excellently suited for forest growth. In fact a considerable proportion of these huge waste areas are covered with soil too good for forest growth—not that forests would not grow excellently in such situations; but that as the soil and configuration are suited for fruit-growing or even for extensive cultivation of agricultural crops, it should be put to these more profitable uses. As is to be expected, however, by far the larger portions of those hills and mountains are suited to forestry alone, their poor or shallow soil, their slope, or rock-strewn surface rendering them unfit for more intensive use. Some of these idle lands are held under private ownership but the greater portion is held by the government. Every consideration urges that these waste lands be put to the various uses to which they are so well adapted,

that they should be made to produce the forest or agricultural crops for which there is such need. Land suitable for agriculture should be put under intensive cultivation. Of that which remains as much as possible should be devoted to fruit-growing, and the remainder, the largest portion of all, to the production of fuel, timber and other products of the forest."

Mr. E. S. Wilson of Harvard Arboretum in his account of eleven years' travel, exploration, and observation in the more remote parts of China, observed: "The forested regions of China are today remote from the populous parts of the country and are only to be found in the more wildly mountainous parts which are little suited to agriculture, and where the rivers are unnavigable rock-strewn torrents..... The scarcity of timber is acutely felt throughout the length and breadth of the land. Dressed logs and poles are carried long distances to navigable waterways and floated either down or up-stream, consequently their cost is high. The ports on the sea board and lower Yangtse import timber in quantity for general construction purposes from Puget Sound and British Columbia."

Mr. Treadwell Cleveland of the United States Forest Service, in his brilliant account of what

forestry has done, writes: "China holds a unique position as the only civilized country which has persistently destroyed its forests. Nowhere in the world is the forest cleaned off down to the very soil as it is in China. When the trees are gone the saplings, the shrubs and even the herbage are taken. Slender poles are used to build houses; inconsiderable shrubs are turned into charcoal. In the lower mountains of north-eastern China, where the stripping process has reached its extreme phase, there is no trace of anything worthy of the name of forest.....

"In the province of Shantung, where deforestation is practically complete, fuel and fodder for cattle are literally scratched from the hill-sides by boys who go out from villages with their iron rakes in autumn to secure winter supplies. Grazing animals, searching every ledge and crevice, crop the remaining grass down to the very roots.

"A dearth of wood is not the only forlorn result of forest devastation; a dearth of water and the ruin of the soil follow in its train. In western China, where forest destruction is not yet complete, enough vegetation covers the mountains to retard the run-off of the rains and return sufficient moisture to lower levels, where it can be reached by the roots of crops and where springs are numerous.

But on the waste hills of eastern China the rains rush off from the barren surfaces, flooding the valleys, ruining the fields, and destroying towns and villages. No water is retained at the higher levels, so that none is fed underground to the lower soils or to the springs. As a result, even on the plains the water level is too far beneath the surface to be used. Without irrigation and the ingenious terracing of hillsides, by which the rains are made to wash the soil into thousands of miniature fields whose edges are propped up walls, agriculture would be entirely impossible. Even irrigation calls for the immense labor of drawing the needed water from wells.

"In a word, the Chinese, by forest waste, have brought upon themselves two costly calamities—floods and water famine."

A missionary for twenty years in the interior of northern Kwangtung, emphasizing this, among other things said: "In this country the level land is not sufficient to grow food for the people, so they are dependent on imports from Kiangsi or from Swatow. At least nine-tenths of the area of the country is too hilly for cultivation. The hills are mostly entirely bare save for fern brakes. Some scrubby pines for firewood are the only semblance of forest culture.

Lumber is very dear and advancing rapidly in price. The climate would be much better and the flow of streams steadied, if the hills were afforested. Some experiments at planting have been made, but the jealousy and suspicion of neighbors, I am informed, made them unsuccessful."

Professor Ross of Wisconsin University, in his travels through China, observed: "On the Kowloon hills opposite Hongkong there are frightful evidences of erosion due to deforestation several hundred years ago. The loose soil has been washed away till the country is knobbed or blistered with great granite boulders. . . . Erosion stripped the soil down to the clay and the farmers had to abandon the land. The denuded hillslopes facing the West River have been torn and gullied till the red earth glows through the vegetation like blood. The coast hills of Fukien have lost most of their soil and show little but rocks. Fuel gatherers constantly climb about them grubbing up shrubs and pulling up the grass. . . . No river could drain the friable loess of Northwest China without bringing down great quantities of soil that would raise its bed and make it a menace in its lower sluggish course. But if the Yellow River is more and more 'China's sorrow' as the

centuries tick off, it is because the rain runs off the deforested slopes of its drainage basin like water off the roof of a house and in wet seasons rolls down terrible floods which burst the immense and costly embankments, spread like a lake over the plain and drown whole populations. . . .

"Nowhere is the havoc wrought by deforestation more evident than in Northwest China. Around Taiyuanfu all the once-wooded mountains are bare and bone dry. Down through the province one sees no trees on mountain or foothill save those about temples. . . .

"Once the tree cover is removed the rains wash the soil from the hillsides and with it fill the water courses and choke the valleys. . . . Buildings are imbedded to the waist in the debris. Gateways that once one could ride a camel through, one can now only creep through on hands and knees. Twice we came upon majestic stone bridges which once spanned broad affluents of the Fen, but which now, their noble arches half silted up, stand unused amid fields of beans and rape, sad monuments of a bygone prosperity. Since the bridge was built, twenty feet of wash from deforested hills has been dropped in that watercourse, and the stream no longer fed from

spongy wooded slopes, is a trickle or an underground moisture in summer and a raging flood in the rainy season."

No doubt the most vivid account of the forestry conditions in China is that by Mr. Purdom, when he endeavored to stir the central Government and provincial officials to a realization of the grave necessity that existed for immediate attention to forestry in China. Mr. Purdom writes: "Fuel is notably scarce in China, but even this does not excuse the wholesale scraping from mountain sides of every particle of vegetation, a matter of compulsory daily occurrence in many provinces, which results in the extinction of all soil binding plants, to say nothing of the many fine species of trees and plants, thus lost to the world. This habit is particularly galling when one thinks of the effect the development of the country's immense coalfields would have on this question of fuel.

" Here and there remnants are to be found of past forests, consisting mainly of pine, fir and larch, and judging from some of the specimens seen, excellent timber for almost any purpose must once have been available. Particularly in the Weichang district, in Chihli, is this apparent. There appears to be in that neighborhood neither

system of felling trees nor any restrictions as to the amount. Thousands of fine poles were observed rotting in the grass, poles, too, of a size suitable for holding telegraph wires. In many parts of Shansi and Kansu, similar denudation exists, but there is no reason why, with organized effort, many parts now barren waste should not be again afforested. Between Jehol and Weichang, too, erosion is hard at work ; deep gullies form in the hillsides every year, the soil and sand thus displaced finding their way to the valleys, widening out the river beds, hiding all trace of roads in places, and making cultivation of crops an impossibility, except on the slopes of the hills.

" Apart from all these considerations the lack of timber will seriously affect the development of the country in such matters as extension of railways, development of mines and building of bridges both from the point of view of cost and facility of carrying out these enterprises. Many small local industries, e.g., the table making in Jehol, and the ornamental work in walnut at Tsin-chow in Kansu, must in time suffer from want of material, though, beside the main issue, this aspect of the matter is comparatively unimportant.

There is, however, another serious factor in the denudation of the land which will one day have

to be considered—the encroachment of sands from the northern deserts. While on a visit to Yulinfu, in north Shansi, the writer was particularly struck by this. For many li south of the Great Wall sand prevails, choking out all signs of vegetation. Here the planting of soil binding plants would prove of the greatest possible benefit, and even further south on the great Peking plain the same policy could be used with a view to protecting the region from the heavy winds which sweep across it in spring.

"Every one who has traveled over the great Chinese plains and felt the discomfort, alike in summer and winter, from the intense heat untempered by shade or the sweeping bitter winds unchecked by "shelter-belts," must acknowledge that if the sides of the tracks crossing the country could be planted with such a tree as the easily attainable, quickly growing poplar, something would have been done towards mitigating these circumstances. Not only would this affect the travelers' personal comfort, but the crops growing between the belts would also have the benefit of protection. Most of the hills bordering the plains are devoid of plant life; the soil has become baked by the sun and time has rendered it sterile. Herbaceous or shrubby vegetation on these heights

would provide shade, and the soil would retain moisture for a much longer period, while, at the same time, the relative humidity of the atmosphere would be increased. Again, the physical enrichment of the soil would be greatly enhanced because of the decayed vegetable matter formed by flowers, leaves, fruits, etc., during the fall."

These testimonies of foreign observers speak for themselves. They have been repeated not only in China, but throughout the world. As Chinese we should take special heed to such warnings. We have borne long enough the various appalling consequences of deforestation and now it is high time that immediate action be taken.

WHERE CHINA STANDS

Now comes the Problem. It has been brought out that forestry is important in human economy. Agriculture alone cannot fully utilize our greatest resource—the land. There must be forestry to go with it. Most nations have long recognized this fact and they have developed definite forestry policies. Thousands of men have been trained to carry out such policies. These men are engaged not only in preserving the forest resources they

already have, but also in reclaiming land that has been lost to production. The millions of dollars France has spent ought to open wide our eyes to the magnitude of a nation-wide reforestation program, since forest waste can be repaired only at great cost. German forestry, which has led in scientific thoroughness, shows what ought to be done with, and got from, lands which are not fit for agriculture.

According to latest information, we learn that our Government has started to organize a Forest Service to be under the Ministry of Agriculture and Commerce. An appropriation of M$181,000 has been set aside for this year, and there are at present about 70 men working in the new service.

Now let us examine and see where China stands when she is brought together with other countries for comparison.

Table I Personnel Forest Services

Countries	Number of men employed in Forest Service
Russia	36,259
India	10,508
Germany	9,300
United States	3,953

Japan	2,872
China	70

The foregoing table shows the number of men employed in the Forest Service of different countries. It is plain that China with her enormous area must greatly increase her working force as time goes on. Germany with an area of 208,810 square miles, or about 1/20 the size of China, has more than 9,000 men working in her Forest Service. If China is to have as efficient a Service as Germany, how many men must she have at her disposal? This we shall watch with a good deal of interest.

Again let us compare the annual expenditures of the Forest Service for some of the countries:

Table II Expenditure of Forest Services

Countries	Expenditure
Germany	M$46,368,000
U. S. A.	9,500,000
India	8,532,000
France	5,244,000
Austria	4,865,000
China	181,000

It is evident that China under the present conditions cannot undertake to do much in fores-

try matters. She is too poor, and very likely she will continue to be so for some time to come. But the lesson which has been clearly brought home by foreign forestry is the need of proper action *now*, so let us hope that the beginning China has made will soon grow to its proper size.

Perhaps some people may want to know where China might stand financially, not to say physically and climatically, if she had most of her non-agricultural lands made productive. This is a point well worth considering.

We have, according to a recent issue of the "Far Eastern Review," about 357,827,000 acres of cultivated land in China proper, Manchuria and Sinkiang, not considering Mongolia and Thibet. If this is a fair estimate, we may conservatively say that there are about 1,207,791,560 acres of land that are either not yet cultivated or not fit for agriculture.

Undoubtedly those lands which are not fit for agriculture form much the larger portion of the uncultivated and they as such should be devoted to forestry purposes. Now if China were to get a net revenue of say $1.00 per acre (ridiculously low) we would get some idea of the enormous revenue which should come from these millions of acres of lands yet to be developed.

What forestry has done in other countries shows, first of all, that forestry pays and that it pays best where the most money is expended in applying it. Both these points are very clearly brought out in the following table taken from United States Forest Service, Circular 140:

Expenditures and Revenues of National Forests

Country	Total net revenue from Government forests.	Expenditure per acre.	Net revenue per acre
Wurttemberg	G$3,098,428	G$2.05	G$6 60
Saxony	G2,299,000	3.00	5.30
Baden	829,162	3.58	4.42
Hesse	744,209	1.25	4.29
Switzerland	237,663	1.32	2.55
Prussia	17,054,144	1.58	2.50
Bavaria	5,128,348	1.99	2.22
France	4,737,250	.95	1.75
Italy			.33
Hungary		.34	.32
Austria	5,313,000	.56	.21
Roumania	482,600		.18
Spain			.17
Sweden	1,677,672	.02	.09
Russia	21,500,000	.01	.032

The above table shows that higher productiveness comes under larger expenditure. The more money China is going to spend in forestry, profit-

ting by experiences of foreign nations, the more revenue she will surely get on account of higher productiveness per acre.

SOME PRACTICAL SUGGESTIONS

Without making any pretension to laying down a complete forestry policy, the carrying out of which would naturally be a rather lengthy process, a few suggestions are here offered which I consider to be practical, and, inasmuch as they involve very little expenditure of money for their carrying out, they ought to claim the immediate attention of our Central and Provincial Governments. I shall now discuss some of these practical suggestions under the following heads:

EDUCATION OF THE PEOPLE

No doubt the most important thing for China to do now is to *educate* her people. Every modern movement depends for its ultimate success upon a sound public opinion and the intelligent support of the people as a whole, and this is especially true of forestry. The people must be educated to understand and to appreciate the importance of forests and their many benefits to the people at large. Such education can be brought about in several ways.

Lecture work among the people is necessarily important. The lectures if made graphic by models, charts, and specimens will be most educative and effective in arousing public interest, and this has been found to be so through experience by the writer. Such demonstrated lectures should be given in every province, and the lecturers, besides preaching on the principles of conservation, should be prepared to answer questions dealing with local forestry problems and to suggest simple and practical solutions for the same. These lectures will be doing what we call "extension work," and it would not be too much if the Central Government required of each province to make a small appropriation, which would be very insignificant indeed, for their support. It may be mentioned that such lecturers ought to become connected with their respective provincial agricultural college.

Then, hand in hand with public lectures and illustrated talks, some systematic newspaper propaganda should be of great value. This should aim at the people of the educated classes who otherwise could not be reached. Perhaps such work can be done best by the Central Forest Service. It is most gratifying to learn that the University of Nanking has started such newspaper propaganda work already. The work as reported

has been most fruitful of results, and inasmuch as it incurs very little expense, our government should have no hesitation in undertaking the same work. The University of Nanking has been receiving letters of encouragement from governors, tao-yuin, missionaries, and newspaper editors, of which the following is a specimen:

> "Your letter and articles have been received. I beg to thank you for the same. In our region agriculture and forestry are rather undeveloped. If you will give us your articles from time to time, not only will the value of our newspaper be increased, but the agricultural and forestry conditions of our district will be improved."

The tone of such a letter cannot but impress upon us the great opportunity of publicity through the press, and doubtless it should be fully utilized in the dissemination of forestry ideas among the people.

Then the Forestry Association is an institution that cannot be dispensed with in the matter of educating the public. It should be composed of men of all professions that are interested in forestry and conservation matters. In the United States, Canada, and other countries, such Associations, representing a combined and organized effort, have played and are still playing an important role in creating and also in keeping public interest in forestry alive. Now if such an institu-

tion is established in China, it would surely exert a guiding influence not only to our people, but also to our government in her legislation on forestry matters.

PROMOTING AND PRESERVING USEFUL EXISTING CUSTOMS

There are some customs in China the observance of which will go far in helping the development of forestry, and such customs should be properly preserved; and any of these customs that are local in extent should be made known to the people at large.

In the vicinity of Yenping, Fukien, there is a custom among the people which no doubt has been partly responsible for the wooded condition of that part of the country. The custom is that of starting a forest plantation at the birth of a male child in the family. The plantation so started is generally cut when it is twenty years old, the time when the boy is old enough to marry. The money obtained from selling the trees is used to defray the wedding expenses of the boy. Such a planting custom is unique, and it will do well for the people of other parts of China to know about it and to observe it if possible.

Again, traveling in the interior of China, one will always find remnants here and there of the original forests, some of which cover good sized tracts. These remnants of forest have been preserved on account of the vicinity of monasteries, the sacred character of the localities, and the useful ideas of fungshui; but as has been brought out "the sentimental appeals of the priests and poetical associations of places and scenery and even the powerful considerations of fungshui appear to be on the wane, and to be giving place to more utilitarian views." If this is true, then it is time that something be done to revive and to preserve these old but useful ideas, and this can be done only through some organized effort. Perhaps the central government can do it readily by co-operating with local clubs and guilds.

The practice of planting a few trees around graves is common in China. Such a practice is very good indeed, and should be preserved. Our system of burying (which may have to be changed) is different from that in the West. The scattered groves of trees we see on hills or plains invariably mark the presence of graves. While the graves are well taken care of, such trees often grow to enormous size, and they ought to make excellent seed trees for the surrounding country if seedlings

are properly handled and protected—a point worth considering from the forestry standpoint.

Perhaps the greatest thing our government has done from the forester's point of view is that of arborizing (if I may use such a word) the Chin Min Festival. Chin Min hitherto has been observed as an occasion for cleaning ancestors' graves and this cleaning consists of chopping down and burning little shrubs and trees that might have grown around the graves. Traveling in the interior of China, we find that most forest fires in the spring have been caused by such cleaning. Now by the presidential mandate of May 1st, 1915, the Chin Min Festival has been made the Arbor Day for China—a day for the whole nation to plant a few trees to show the importance of the forest tree in the life of a nation. That such a mandate has been issued is significant and if properly carried out every year, should go very far towards promoting forestry among the masses.

In the "China Press" of April 7th, this year, we find the following account about the observance of Chin Min Festival in Hangchow:

"Chin Min was celebrated here as usual but a new and significant feature was added in the observation of Arbor Day. It was the first observ-

ance of this day in the Province and the beginning of a conservation movement which will have great bearing on the industrial life of the Province.....

"During the past few weeks more than twenty thousand trees have been set out on the hills around West Lake and within the present year three million seedlings and trees are to be set out..... Special Arbor Day exercises were held this morning to take the public into the work. A number of the schools sent representatives, the civil Governor sent a representative in the person of the Commissioner of the water police, the Taoyuin, and the local Magistrate were both present. They and a number of other prominent visitors took part in setting out a number of trees.....The principal speaker on the program spoke on the importance of the exercises of the day as an example and inspiration for the Province, but he placed the strongest emphasis on the preservation of the trees which were being set out....."

Again in Nanking, Anking and other places we heard that thousands of students, officials and gentry turned out to celebrate the first Arbor Day of China. Right here our attention might be drawn to the possibility of arborizing in one way or another some other existing festivals or customs. It is certainly far from being too much to have the

whole nation think about, say two or three times a year, the importance of forest trees as guardians and custodians of the necessaries of life and the happiness of the nation.

In connection with arbor days, I might suggest that each hsien or district devote a good sized tract of land specially for their celebration. It should be non-agricultural, central and easily accessible; and on it there should be roads laid out to facilitate planting. Planted areas on the tract will increase in size naturally with each celebration of public planting, until the entire tract is planted over. When the different plantations grow up, they ought to serve as a sort of demonstration forest or as a park for the people of that hsien. The local magistrate or a committee of village elders will be held responsible for the protection and management of such a planted forest. It is estimated that we have 1,783 hsien in China and to have 1,783 hsien forests started all over China will mean a great deal to the development of forests in this country. Such forests will be like "communal" forests and if they are properly cared for they ought to serve to demonstrate to people the practicability and advisability of reforestation, not to say they will serve as wholesome playgrounds for the hsien

people. But "to see a thing once is better than to be told about it a thousand times," so there is no better way of showing the people the many benefits of forests than by giving them opportunities to go to places where they see and feel for themselves.

SOME INEXPENSIVE GOVERNMENT ACTIONS

Under this head I wish to bring out one or two points which I consider as being distinctly government actions. Like those above, they are practical and will involve little or no expense on the part of the government.

It seems that one thing the government can do and ought to do is that of drawing up some kind of an agreement concerning reforestation whenever she grants mining or railroad concessions within her territory. In the case of mining concessions, for instance, there should be in the stipulations with mining companies forestry clauses which require the companies to afforest and to re-afforest areas that have been mined. In this way the Government does not need to spend a cent to have many of her hills and mountains planted.

Again in the case of railroad construction some rules might be had to get different railroad

officials to plant trees on each side all along the lines to the width of say 500 feet more or less whenever possible. Such plantings besides beautifying the country ought to make good investments for the railroad companies in 15 years or so, in view of the constant demand for ties for construction and renewals.

Besides mining and railroad construction there are certain other enterprises—Government or private—which can likewise be made to do reforestation work in places where the enterprises are located.

It is evident, then, that China must have some definite forestry policy in her dealing with concerns like those above, which she can depend on to do a good deal of reforestation work for her at their expense. China is becoming industrially developed every day, and the carrying out of such a forestry policy, inexpensive as it is, should mean a sure and gradual addition of forested area within her bounds.

There is another thing which our government might do, which is purely educational, and that is to devote a little space to forestry in some of our text books used in primary or high schools. It seems that the child should be given an

opportunity to understand forestry as one of the important economic and public questions in the life of the world. He should be told, for instance, in his study of geography, how forests influence streamflow; how the removal of forests has caused our floods to become worse and worse; and in his nature study work he should be taken to see the work of little torrents, how exposed soil is washed and gullied and how various kinds of vegetation modify these effects. Such knowledge as the child gets will leave lasting impressions and will qualify him later on to take an active and intelligent interest in shaping the nation's forestry policy. The teaching of some agriculture and forestry in elementary schools has been advocated and to some exent tried out in the Western countries, and the successes that have attended their efforts show that it will do well for China to give forestry and certainly agriculture, their just shares of the space in some of her text books for use of the schools. It is hoped that our Ministry of Education will consider such a point raised.

Perhaps the most urgent thing our Government should do now is to provide reasonably adequate protection to the tens of thousands of people who would be only too glad to take up forestry either as their vocation or avocation.

Such people are not ignorant of the effects of forest planting and of forest denudation. They have not allowed an inch of their agricultural soil to go to waste, and surely they do not care to see thousands of acres of land that ought to be devoted to forestry, remaining idle, unproductive and a detriment to society.

Traveling and lecturing in the interior of Fukien, Chekiang, Anhwei, and other places, I have met with hundreds of people who would say: "We all know forestry and the importance of forestry. We love to reforest our hills and make them as productive as our farms but circumstances don't permit us. We have not proper forest protection. Some of our neighbors may accidentally, carelessly or otherwise, start a fire that burns over our planted areas, thus killing our attempts at reforestation; again others may steal or chop down trees before they are matured." I have heard such complaints time and again, and certainly there should be immediate action taken to remedy such a state of affairs. After all it is proper protection to people that is most important. Any amount of lecturing and educating may be done, but unless the people are given proper protection to their undertaking, forestry or any

other occupation, they can not be expected to do very much.

To reclaim and to reforest millions of acres of our waste lands is a prodigious task. Our central government alone can not do this. Much will have to depend upon private effort and private effort can not be had unless it is accorded proper protection.

Now how can we protect private plantings and plantings in general, against fire and theft, the two greatest enemies to the practice of forestry? Without going into detailed discussion of the subject of forest protection, I would like to make a suggestion which I consider practical and the carrying out of which entails little expense.

It seems that every hsien should have what we call a fire warden or forest police and if the hsien is large and mountainous, it may employ two wardens.

The warden will be in the employ of the hsien government, acting under the advice of both the local magistrate and a committee of local men. In view of the constant transfer of local magistrates from one hsien to another, it would be better to leave the selection of the warden in the hands of the committee, who naturally can do the

selecting more efficiently on account of their knowledge of local conditions. The warden should be in uniform and should always be traveling from place to place within the hsien. His duties may be briefly outlined as follows:

1. To make visits and to hold conferences with men in different places that are interested in forest protection.

2. To post notices warning people concerning fires, theft, and punishment for such misdemeanor.

3. To report to the local magistrate persons who have violated the forest laws (our central government in December of 1914 promulgated a set of well considered forest laws).

Evidently it would be quite difficult for the warden alone to carry out satisfactorily the different lines of work as outlined above. But, even single-handed he could do much by co-operating closely with the people in the different parts of the hsien. Such a suggested plan for protection it must be remembered is only meant to tide over the present situation. For complete prevention and control of forest fires there must be a much greater force, plus a system of fire lines, lookout stations, etc., but such we know can not be had in China for many years to come.

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